# APPENDIX K

## ESSENTIAL FISH HABITAT

# DRAFT - Essential Fish Habitat Assessment

## 1. Essential Fish Habitat Background

The regional fisheries management councils, with assistance from National Marine Fisheries Service (NMFS), are required under the 1996 amendments to Magnuson-Stevens Fishery Management and Conservation Act to delineate Essential Fish Habitat (EFH) for all managed species, minimize to the extent practicable adverse effects on EFH caused by fishing, and identify other actions to encourage the conservation and enhancement of EFH.

EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity” (NMFS, 2016a). In addition, the presence of adequate prey species is one of the biological properties that can define EFH. The regulations further clarify EFH by defining “waters” to include aquatic areas that are used by fish (either currently or historically) and their associated physical, chemical, and biological properties; “substrate” to include sediment, hard bottom, and structures underlying the water; areas used for “spawning, breeding, feeding, and growth to maturity” to cover a species’ full life-cycle; and “prey species” as being a food source for one or more designated fish species (NMFS, 2016ba).

Pursuant to Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act, Federal agencies are required to consult with the NMFS regarding any action they authorize, fund, or undertake that may adversely affect EFH. For assessment purposes, an adverse effect has been defined in the Act as follows: “Any impact which reduces the quality and/or quantity of EFH. Adverse effects may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey, reduction in species fecundity), site specific or habitat wide impacts, including individual, cumulative, or synergistic consequences of actions.”

The objective of this EFH assessment is to describe the potential adverse effects to designated EFH for federally-managed fisheries species within the project site. It will also describe the conservation measures proposed to avoid, minimize or otherwise offset potential adverse effects to designated EFH resulting from the recommended plan.

## 2. Project Description

In the aftermath of Hurricane Sandy, many potential actions have been proposed to reduce storm-related effects to the region. After a thorough review of the published literature as well as meetings with communities and other stakeholders, five principal planning objectives have been identified. These planning objectives are intended to be achieved throughout the study period, which is from 2020 – 2070:

- Reduce vulnerability to storm surge impacts;
- Reduce future flood risk in ways that will support the long-term sustainability of the coastal ecosystem and communities;
- Reduce the economic costs and risks associated with large-scale flood and storm events;
- Improve community resiliency, including infrastructure and service recovery from storm effects; and
- Enhance natural storm surge buffers, also known as natural and nature-based features (NNBFs), and improve coastal resilience.

An array of structural and non-structural management measures, including NNBFs, were developed to address one or more of the planning objectives. Management measures were developed in consultation with the non-federal sponsor (NYSDEC), state and local agencies, and non-governmental entities. Measures were evaluated for compatibility with local conditions and relative effectiveness in meeting planning objectives.

Effective measures were combined to create CSRM alternatives for two distinct planning reaches: the Atlantic Ocean shorefront and Jamaica Bay. Integrating CSRM alternatives for the two reaches provides the most economically efficient system-wide solution for the vulnerable communities within the study area. It is important to note that any comprehensive approach to CSRM in the study area must include an Atlantic Ocean shorefront component because overtopping of the Rockaway peninsula is a source of flood waters into Jamaica Bay. Efficient CSRM solutions were formulated specifically to address conditions at the Atlantic Ocean Shorefront Planning Reach. The best solution for the Atlantic Ocean Shorefront Planning Reach was included as a component of the alternative plans for the Jamaica Bay Planning Reach.

The USACE is proposing a phased decision-making process to address the needs for these two areas in a tiered approach. The USACE New York District evaluated and selected measures along the Atlantic Ocean shorefront on the Rockaway peninsula, which are ripe for decision making at this time, and is deferring final decisions on Jamaica Bay-wide measures until additional analysis are completed. This approach consolidates the extensive Atlantic Ocean shorefront analyses conducted prior to Hurricane Sandy with post-Sandy analyses. The first phase of decision making will be based on the Tier 1 analysis providing the basis for construction recommendations to address erosion, storm surge, and wave damage along the Atlantic Ocean shorefront. The Tier 1 recommendation will independently provide coastal storm risk management benefits until such time that remainder of the Inlet Barrier alternative is constructed. The Tier 2 analysis will address the details of Inlet Barrier construction and will provide the basis for a finalized Inlet Barrier alignment and related decisions for the interior of Jamaica Bay. The focus of this EFH assessment will be the Tier 1 decision-making to support he implementation of the Tentatively Selected Plan (TSP) for the oceanfront.

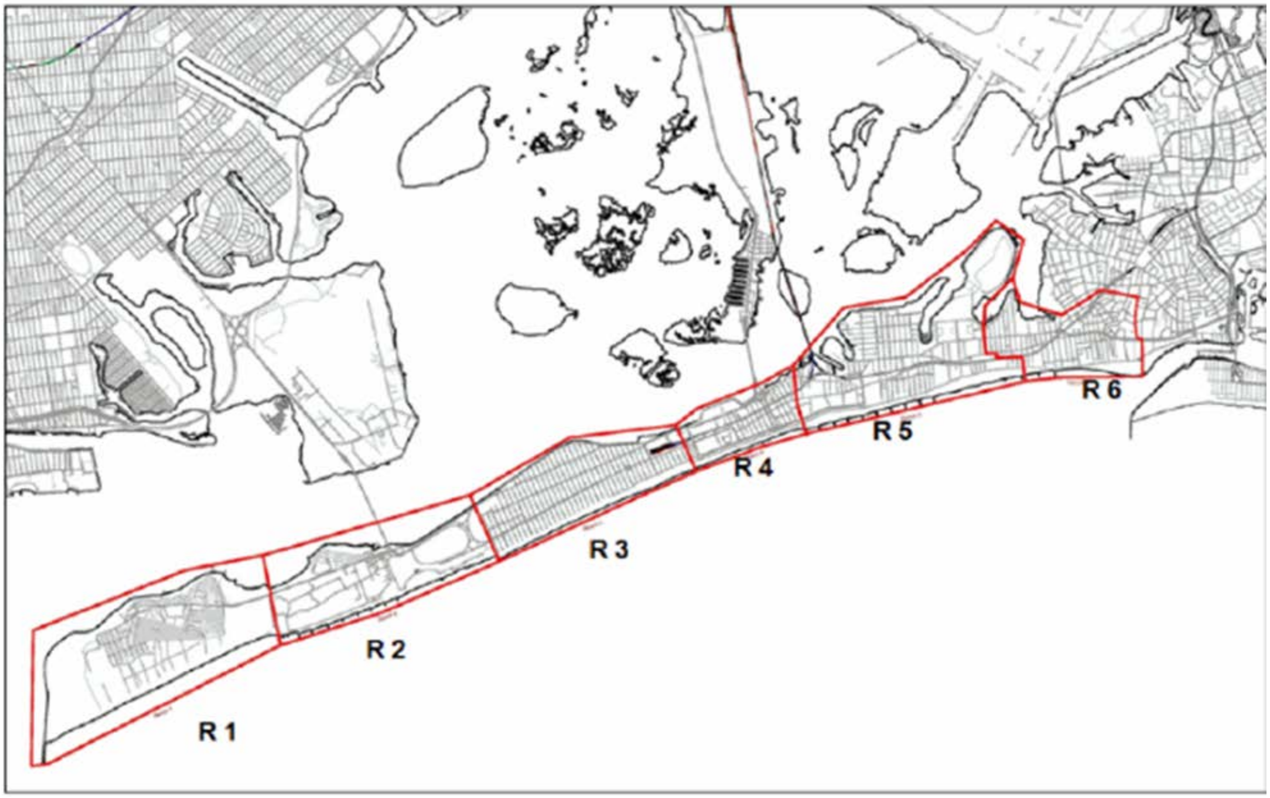
## 2.1 Atlantic Ocean Shorefront

The Atlantic Ocean Shorefront Planning Reach along the Rockaway Peninsula is subdivided into six reaches for the purpose of this analysis. Each reach is developed based upon site-specific physical, economic, and institutional differences. Considerations include hydrodynamic differences, coastal features, sediment transport boundaries, shoreline stability, existing projects, and development patterns. Reach designations help characterize the problems, needs, and opportunities and to identify alternatives viable for each reach. Division of the Atlantic Ocean Shorefront Planning Reach into reaches does not imply separable projects or construction areas.

The six Atlantic Ocean shorefront reaches (Figure 1) include:

- Reach 1: Rockaway Point to Beach 193rd Street;
- Reach 2: Beach 193rd Street to Beach 149th Street;
- Reach 3: Beach 149th Street to Beach 109th Street;
- Reach 4: Beach 109th Street to Beach 86th Street;
- Reach 5: Beach 86th Street to Beach 42nd Street; and
- Reach 6: Beach 42nd Street to Beach 9th Street

Figure 1. Six Atlantic Ocean Shorefront Reaches.




The Atlantic Ocean shorefront CSRMU has been developed to a higher level of detail than other components of the alternative plans because of its significance as the primary CSRM feature addressing ocean side wave attack and wave run up on the Rockaway peninsula and because substantial analyses had been performed just prior to and immediately following Hurricane Sandy, which had not been performed for other CSRMUs. The general approach to developing this CSRMU was to evaluate erosion control alternatives in combination with a single beach restoration plan to select the most cost effective renourishment approach prior to the evaluation of alternatives for coastal storm risk management.

The general approach to developing CSRM for the Atlantic Ocean Shorefront Planning Reach was to evaluate features that optimize life-cycle costs as a first step in developing overall CSRM for the Planning Reach. The optimal life-cycle cost feature is Beach Restoration + Increased Renourishment (Figure 2).

Figure 2. Beach Restoration with Increased Renourishment


Beachfill quantities required for initial construction of the selected alternative was estimated based on the expected shoreline position in June of 2018. It is impossible to predict the exact shoreline position in June 2018 since the wave conditions vary from year to year and affect shoreline change rates. The shoreline position in June of 2018 was estimated based on a 2.5 year GENESIS-T simulation representative of typical wave conditions. Beachfill quantities are based on the difference in the design shoreline position (including advance fill) and the June 2018 shoreline. For every foot that the June 2018 shoreline needs to be translated seaward requires 1.22 cy/ft of fill, based on berm elevation of +8 ft NAVD and a depth of closure of -25 ft NAVD. Beachfill quantities are included in Table 1, and includes an overfill factor of 11% based on the compatibility analysis for the borrow areas.

Table 1: Beachfill and Renourishment Quantities (cubic yards)

| Reach | Beachfill | Renourishment per Cycle |
|---|---|---|
| Reach 3 | 279,000 | 444,000 |
| Reach 4 | 74,000 | 133,000 |
| Reach 5 | 227,000 | 444,000 |
| Reach 6a | 204,000 | 0 |
| Reach 6b | 20,000 | 0 |
| Totals | 804,000 | 1,021,000 |

Note: Renourishment would occur on a four-year cycle

A renourishment interval of 4 years was developed, which is projected to result in advance berm widths of approximately 60 feet along the placement area. Renourishment in Reach 6a is not included as a part of the project because of annual East Rockaway Inlet dredging, which is projected to place 115,000 cubic yards of material on this reach annually.

Generally a groin is comprised of three sections: 1) horizontal shore section (HSS) extending along the design berm; (2) an intermediate sloping section (ISS) extending from the berm to the design shoreline, and (3) an outer sloping section (OS) that extends from the shoreline to offshore. The head section (HD) is part of the OS and is typically constructed at a flatter slope than the trunk of the groin and may require larger stone due to the exposure to breaking waves. Table 2 presents the location and length of groin sections depicted in Figure 2 (above).

Table 2: Groin Locations and Lengths (feet)

| Street | HSS | ISS | OS | Total | Description |
|---|---|---|---|---|---|
| 34th | 90 | 108 | 328 | 526 | New 526’ |
| 37th | 90 | 108 | 328 | 526 | Extension 175’ |
| 40th | 90 | 108 | 328 | 526 | Extension 200’ |
| 43rd | 90 | 108 | 228 | 426 | Extension 75’ |
| 46th | 90 | 108 | 228 | 426 | Extension 150’ |
| 49th | 90 | 108 | 228 | 426 | Extension 200’ |
| 92nd | 90 | 108 | 128 | 326 | New 326’ |
| 95th | 90 | 108 | 128 | 326 | New 326’ |
| 98th | 90 | 108 | 128 | 326 | New 326’ |
| 101st | 90 | 108 | 128 | 326 | New 326’ |
| 104th | 90 | 108 | 128 | 326 | New 326’ |
| 106th | 90 | 108 | 128 | 326 | New 326’ |
| 108th | 90 | 108 | 128 | 326 | New 326’ |
| 110th | 90 | 108 | 153 | 351 | New 351’ |
| 113th | 90 | 108 | 178 | 376 | New 376’ |
| 115th | 90 | 108 | 178 | 376 | New 376’ |
| 118th | 90 | 108 | 178 | 376 | New 376’ |
| 121st | 90 | 108 | 128 | 326 | New 326’ |

A screening analysis was performed to evaluate the level of overall CSRM provided by a range of dune and berm dimensions and by reinforced dunes, which would be combined with Beach Restoration +

Increased Renourishment to optimize CSRM at the Atlantic Ocean Shorefront Planning Reach. Other factors such as prior projects at Rockaway Beach, project constraints, stakeholder concerns, and engineering judgment were also applied in the evaluation and selection (see the Plan Formulation Appendix).

CSRM at the Atlantic Ocean Shorefront Planning Reach consists of optimized beach restoration and increased renourishment plus a composite seawall, which provides the highest net benefits of all Atlantic Ocean shorefront alternatives considered. The composite seawall protects against erosion and wave attack and also limits storm surge inundation and cross-peninsula flooding (Figures 3 and 4). The structure crest elevation is +17 feet (NAVD88), the dune elevation is +18 feet (NAVD88), and the design berm width is 60 feet. The armor stone in horizontally composite structures significantly reduces wave breaking pressure, which allows smaller steel sheet pile walls to be used in the design if the face of the wall is completely protected by armor stone. The composite seawall may be adapted in the future to rising sea levels by adding 1-layer of armor stone and extending the concrete cap up to the elevation of the armor stone.

Figure 3. Composite Seawall Beach 19th St. to Beach 126th St.

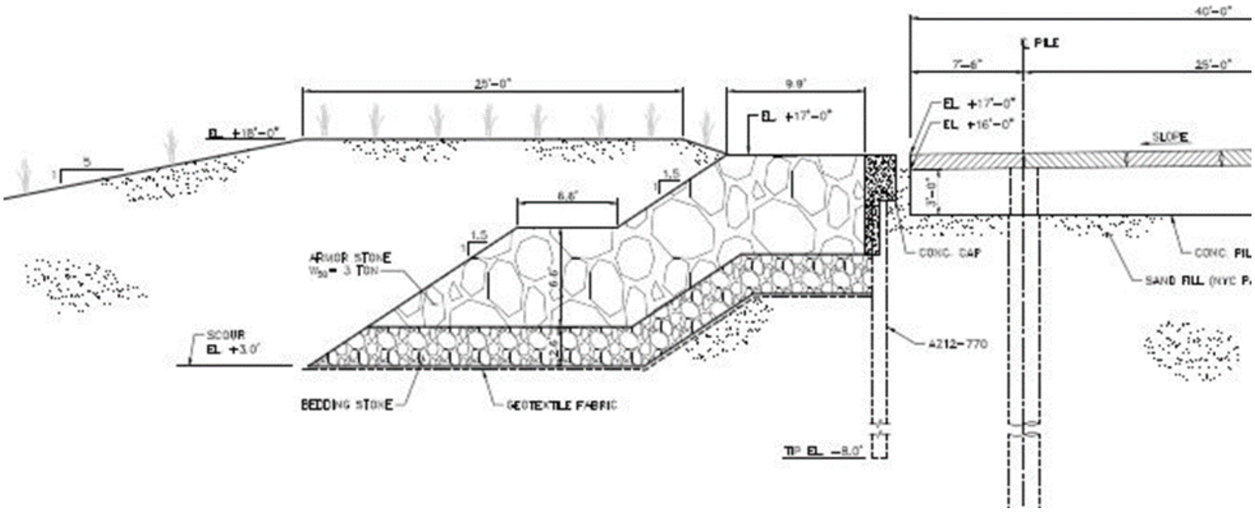
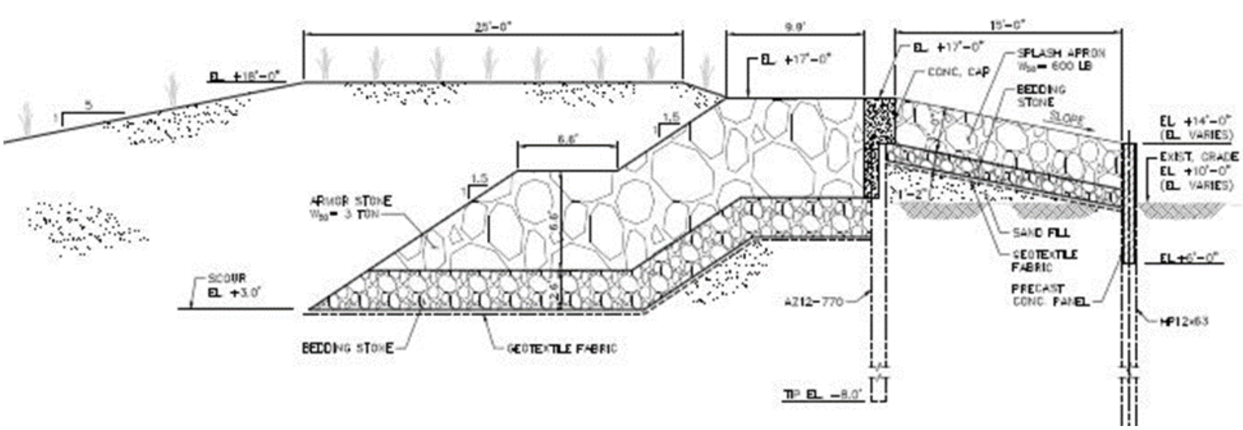



Figure 4. Composite Seawall Beach 126th St. to Beach 149th St.



## 2.2 Jamaica Bay Alternatives

The alternative plans for the Jamaica Bay Planning Reach include the best solution for the Atlantic Ocean Shorefront Planning Reach, which would substantially reduce overtopping of the Rockaway peninsula as a source of flood waters into Jamaica Bay. Alternative plans for the Jamaica Bay Planning Reach also include necessary tie-ins at Coney Island and at the eastern end of the Rockaway peninsula. The TSP for the Jamaica Bay Planning Reach includes the Storm Surge Barrier Plan.

Three potential alternative alignments of the Storm Surge Barrier Plan were assessed as part of the Storm Surge Barrier Plan. Each alternative alignment consists of the optimized plan for the Atlantic Ocean Shorefront Planning Reach, two tie-ins (Coney Island tie-in and the Rockaway shorefront eastern tie-in) and alignment-specific variations of the Jamaica Bay Northwest CSRM unit and the Rockaway Bayside CSRM unit.

Alignment C-2 and two alternative alignments for C-1 (C-1E and C-1W) were analyzed using the ADCIRC numerical model to evaluate changes in tidal amplitude and velocities in Jamaica Bay for various gate configurations and Storm Surge Barrier alignments. Storm Surge Barrier alignment C-1E is preferred over alignment C-1W because alignment C-1E:

- would likely result in less impact to the Gil Hodges Memorial Bridge;
- would result in less real estate and aesthetic impacts to the Roxbury Community where alignment C-1W would tie in;
- is located in a more stable channel location; and
- avoids potential impacts to submerged cables.

The ADCIRC modeling identified alignment C-1E with 1,100 linear feet of gate opening and alignment C-2 with 1,700 linear feet of gate opening as having the least hydrodynamic impacts to the bay (Table 3). Both alignments result in a maximum tidal amplitude change of 0.2 feet, which indicates that there would not be any major changes in the water column throughout the bay. Limited changes to the water column indicates that the natural environment driven by water circulation would be undisturbed and water chemistry, including the benthic layer, would be consistent with and without a Storm Surge Barrier. In addition, flow speeds and directions for both alignments are similar to without-project conditions, which imply that circulation within the bay would be minimally impacted.

Table 3: Storm Surge Barrier Alternative Alignment Gate Opening Aggregate Length

| Alignment | Total Opening (ft) | Number of 100-foot Vertical Lift Gates | Number of 200-foot Sector Gates |
|---|---|---|---|
| C-1E | 1,100 | 7 | 2 |
| C-2 | 1,700 | 11 | 3 |

Storm Surge Barrier Alignment C-1E includes a Storm Surge Barrier (design elevation = 16.0 feet NAVD88) with seven 100-foot wide vertical lift gates and two 200-foot wide sector gates (Figure 5). Alignment C-1E runs in a northwesterly direction from Jacob Riis Park on the Rockaway peninsula to Barren Island at Floyd Bennet Field, Gateway National Recreation Area (HB-01). On the Rockaway peninsula, alignment C-1E ties in to the Rockaway Bayside CSRM unit, which continues west along the

Rockaway peninsula and around Breezy Point prior to tying into the Atlantic Ocean Shorefront Planning Reach (RPV-16). Note that an alternative alignment for the Rockaway Bayside CSRM unit would include a southwestern terminus at Beach 169th Street, which avoids alignments around Breezy Point. This alternative alignment would tie-in to high ground at the Marine Parkway Bridge ramps to the north (RPV-13) and to the south at the Atlantic Ocean Shorefront Planning Reach (RPV-16). At the eastern end of the Rockaway peninsula alignment C-1E ties in to high ground at the Rockaway shorefront eastern tie-in.

On Barren Island, alignment C-1E ties in to a modification of the Jamaica Bay Northwest CSRM unit (HB-01), which runs from the U.S. Marine Corps Reserve Center at Floyd Bennett Field north along Flatbush Avenue. At the Belt Parkway, the Jamaica Bay Northwest CSRM unit continues west along the same alignment identified for the Jamaica Bay Perimeter Plan (JBV-00 through JBV-04) with the western terminus of the unit tying in Coney island. This modified version of the Jamaica Bay Northwest CSRM unit includes floodgates at Sheepshead Bay (JBV-01) and Gerritsen Inlet (JBY-03).

Figure 5: Storm Surge Barrier Plan C-1E


Storm Surge Barrier Alignment C-2 includes a Storm Surge Barrier (design elevation = 16.0 feet NAVD88) with eleven 100-foot wide vertical lift gates and three 200-foot wide sector gates (Figure 6).

Alignment C-2 runs in a northwesterly direction from approximately Beach 218th Street on the Rockaway peninsula to Seawall Avenue at Kingsborough Community College (HB-02). On the Rockaway peninsula, alignment C-2 ties in to the Rockaway Bayside CSRM unit. For this alignment the Rockaway Bayside CSRM unit continues west along the Rockaway peninsula, circles around the tip of the peninsula around Breezy Point, then turns east prior to tying into the Atlantic Ocean Shorefront Planning Reach (RPV-16).

At Kingsborough Community College, alignment C-2 ties in to a modification of the Jamaica Bay Northwest CSRM unit (HB-01), which runs from Kingsborough Community College west to the terminus at Manhattan Beach. This modified version of the Jamaica Bay Northwest CSRM unit does not include tributary floodgates. Storm Surge Barrier alignment C-2 also includes the Coney Island tie-in and the Rockaway shorefront eastern tie-in CSRM units.

Figure 6: Storm Surge Barrier Plan C-2


The Storm Surge Barrier, which includes CSRM at the Atlantic Ocean Shorefront Planning Reach, is currently the TSP. Additional information describing project elements can be referenced in *Draft Hurricane Sandy General Reevaluation Report and Environmental Impact Statement*. In addition, the project elements will be refined as part of the later design phases of the project.

### 2.3 Jamaica Bay Planning Reach Tie-ins

The Rockaway shorefront CSRM unit optimization was conducted for reaches 3 – 6 along the Rockaway shorefront (beach 149th Street to Beach 19th Street). It is assumed that similar design elevations and costs are applicable for Rockaway shorefront reaches 1 and 2 up to the tie-in with the Rockaway bayside CSRM unit.

#### 2.3.1 Rockaway Shorefront Eastern Tie-in

The Rockaway Shorefront eastern tie-in consists of an eastward extension of the Rockaway shorefront CSRM unit running along the backside of the beach until it turns inland at Beach 17th Street. The alignment continues until termination near the north end of the Yeshiva Darchei Torah campus. The alignment includes concrete floodwalls and two roadway gates.

#### 2.3.2 Coney Island Tie-in

At the Alternatives Milestone Meeting it was assumed that the Storm Surge Barrier alternative and the Jamaica Bay Perimeter Plan alternative would have their western terminus at a tie-in at Corbin Place on Coney Island. For the TSP Milestone this tie-in has been extended west in coordination with the Coney Island Creek Tidal Barrier and Wetland Feasibility Study (NYCEDC). The revised Coney Island tie-in alignment includes Coney Island Beach, Sea Gate, Coney Island Creek, and Gravesend, tying into high ground at Bensonhurst Park. The alignments and feasibility level cost information have been provided for this analysis by NYCEDC.

#### 2.3.3 Jamaica Bay Northwest CSRM Unit

The full extent of the Jamaica Bay Northwest CSRM unit runs from Coney Island to Bergen Basin, which had previously been identified as alignment D-7 for the Alternatives Milestone. The full extent of the Jamaica Bay Northwest CSRM unit is a major component of the Jamaica Bay Perimeter Plan (Plan D). Shorter sections at the western end of the Jamaica Bay Northwest CSRM unit are required to achieve the full functionality of the Storm Surge Barrier Plan by providing a tie-in between the Storm Surge Barrier and the CSRM structure at Coney Island. The design and cost of the Manhattan Beach section of the Jamaica Bay CSRM unit is based on the Rockaway Shorefront CSRM unit composite seawall design and costs.

## 3 EFH Designations

The species and life stages that have designated EFH in the project area were determined using the *Guide to Essential Fish Habitat Designations in the Northeastern United States* found on the NMFS website (NMFS, 2016b). The 10’ x 10’ square of latitude and longitude within which the project area falls was selected and Tables 4 and 5 were generated. Table 1 details the 10’ x 10’ square coordinates and is followed by a short but detailed description of the square, including landmarks along the coastline. Table 4 lists the designated EFH species for the project area. The notation "X" indicates that EFH has been designated within the 10’ x 10’ square for a given species and life stage. The notation "n/a" indicates that the species either have no data available on the designated life stages or those life stages are not present in the species' reproductive cycle.

Table 4. 10’ x 10’ Square Coordinates and Description

| | North | East | South | West |
|---|---|---|---|---|
| Square 1 | 40º 40.0’ N | 73º 50.0’ W | 40º 30.0’ N | 74° 00.0’ W |
| Square 2 | 40º 40.0’ N | 73º 40.0’ W | 40º 30.1’ N | 73º 50.0’ W |

Square 1 Description: Atlantic Ocean waters within the square within the Hudson River estuary affecting the following: western Rockaway Beach, western Jamaica Bay, Rockaway Inlet, Barren I., Coney I. except for Norton Pt., Paerdegat Basin, Mill Basin, southwest of Howard Beach, Ruffle Bar, and many smaller islands.

Square 2 Description: Atlantic Ocean waters within the square within Great South Bay estuary affecting the following: Western Long Beach, NY., Hewlett, NY., Woodmere, NY., Cedarhurst, NY., Lawrence, NY., Inwood, NY., Far Rockaway, NY., East Rockaway Inlet, eastern Jamaica Bay, Brosewere Bay, Grassy Bay, Head of Bay, Grass Hassock Channel, eastern Rockaway Beach, Atlantic Beach, Howard Beach, J. F. K. International Airport, Springfield, NY., and Rosedale, NY., along with many smaller islands.

Table 5. Designated EFH Species and Life Stages

| Species | | Eggs | Larvae | Juveniles | Adults |
|---|---|---|---|---|---|
| 1 | Atlantic salmon (*Salmo salar*) | | | | X |
| 2 | Atlantic cod (*Gadus morhua*) | | | | |
| 3 | haddock (*Melanogrammus aeglefinus*) | | | | |
| 4 | pollock (*Pollachius virens*) | | | X | |
| 5 | whiting (*Merluccius bilinearis*) | X | X | X | |
| 6 | red hake (*Urophycis chuss*) | X | X | X | |
| 7 | witch flounder (*Glyptocephalus cynoglossus*) | | | | |
| 8 | winter flounder (*Pleuronectes americanus*) | X | X | X | X |
| 9 | yellowtail flounder (*Pleuronectes ferruginea*) | | | | |
| 10 | windowpane flounder (*Scopthalmus aquosus*) | X | X | X | X |
| 11 | American plaice (*Hippoglossoides platessoides*) | | | | |
| 12 | ocean pout (*Macrozoarces americanus*) | | | | |
| 13 | Atlantic sea scallop (*Placopecten magellanicus*) | | | | |
| 14 | Atlantic herring (*Clupea harengus*) | | | X | X |
| 15 | monkfish (*Lophius americanus*) | X | X | | X |
| 16 | Little skate (*Leucoraja erinacea*) | | | X | X |
| 17 | Winter skate (*Leucoraja ocellata*) | | | X | X |
| 18 | bluefish (*Pomatomus saltatrix*) | | | X | X |
| 19 | long finned squid (*Loligo pealei*) | n/a | n/a | X | |
| 20 | short finned squid (*Illex illecebrosus*) | n/a | n/a | | |
| 21 | Atlantic butterfish (*Peprilus triacanthus*) | X | X | X | X |
| 22 | Atlantic mackerel (*Scomber scombrus*) | X | X | X | X |
| 23 | summer flounder (*Paralicthys dentatus*) | | X | X | X |
| 24 | scup (*Stenotomus chrysops*) | X | X | X | X |
| 25 | spiny dogfish (*Squalus acanthias*) | n/a | n/a | | |
| 26 | black sea bass (*Centropristus striata*) | n/a | | X | X |
| 27 | surf clam (*Spisula solidissima*) | n/a | n/a | | |
| 28 | ocean quahog (*Artica islandica*) | n/a | n/a | | |
| 29 | tilefish (*Lopholatilus chamaeleonticeps*) | | | | |
| 30 | king mackerel (*Scomberomorus cavalla*) | X | X | X | X |
| 31 | Spanish mackerel (*Scomberomorus maculatus*) | X | X | X | X |
| 32 | cobia (*Rachycentron canadum*) | X | X | X | X |
| 33 | sand tiger shark (*Odontaspis taurus*) | | X | | |
| 34 | blue shark (*Prionace glauca*) | | | | X |
| 35 | dusky shark (*Charcharinus obscurus*) | | X | | |
| 36 | sandbar shark (*Charcharinus plumbeus*) | | X | X | X |

| Species | | Eggs | Larvae | Juveniles | Adults |
|---|---|---|---|---|---|
| 37 | tiger shark (*Galeocerdo cuvieri*) | | X | | |

As shown on Table 5, the project site has been identified as EFH for 37 species of fish. Numbers 1 to 17 are New England Species; numbers 18 to 29 are Mid-Atlantic species; numbers 30 to 32 are South Atlantic species; numbers 33 to 37 are Coastal Migratory Pelagic Species; and numbers 20 to 23 are Highly Migratory Species. The life stages of the Highly Migratory Species are broken down into neonates, juveniles, and adults. There are no 'egg' designations and neonates correspond to the “larvae” heading.
The following text provides a description of general habitat parameters of the 37 designated EFH species and the applicable life stages specific to the EFH assessment. The habitat parameters and species drawings were obtained from the *Guide to Essential Habitat Descriptions* and where necessary, supplemented by the *EFH Tables* (NMFS 2016d). If more than one geographic region was given in a description, the habitat parameters for the geographic region associated with the project area were used.

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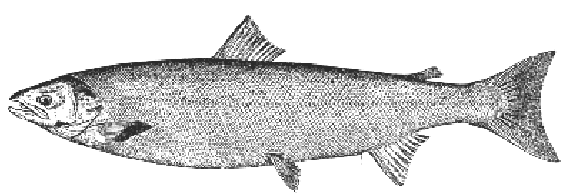
3.1 New England Species

**Atlantic salmon** *(Salmo salar)*

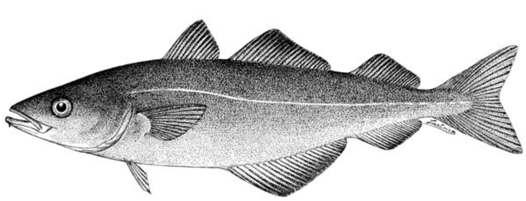
Eastern portions of the Atlantic Ocean along Long Island are designated as EFH habitat for salmon adults in the seawater salinity zone, mixing water/brackish salinity zone, and the tidal freshwater salinity zone. The habitat parameters for the applicable life stages are as follows.



Adults: Generally, the following conditions exist where Atlantic salmon adults are found migrating to the spawning grounds: streams with water temperatures below 22.8°C and dissolved oxygen above 5 parts-per-million (ppm). Oceanic adult Atlantic salmon are primarily pelagic and range from the waters of the continental shelf off southern New England north throughout the Gulf of Maine.

**pollock** *(Pollachius virens)*

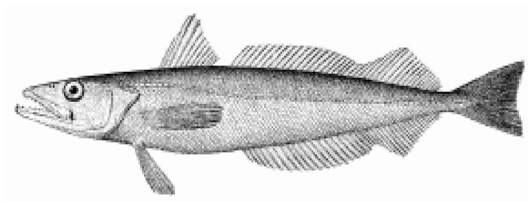
The project site is designated as EFH for pollock juveniles. The habitat parameters for the applicable life stages are as follows.



Juveniles: Generally, the following conditions exist where most pollock juveniles are found: water temperatures below 18°C, water depths between 0 and 250 meters, and salinities greater than 29 and 32%.

**whiting** (*Merluccius bilinearis*)

The project site is designated as EFH for whiting eggs, larvae, and juveniles. The habitat parameters for the applicable life stages are as follows.



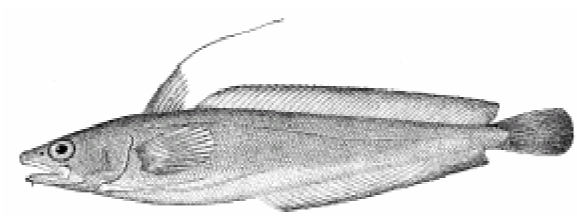
Eggs: Generally, the following conditions exist where most whiting eggs are found: sea surface water temperatures below 20°C and water depths between 50 and 150 meters. Whiting eggs are observed all year, with peaks from June through October.

Larvae: Generally, the following conditions exist where most whiting larvae are found: sea surface water temperatures below 20°C and water depths between 50 and 130 meters. Whiting larvae are observed all year, with peaks from July through September.

Juveniles: Generally, the following conditions exist where most whiting juveniles are found: water temperatures below 21°C, water depths between 20 and 270 meters, and salinities greater than 20%.

**red hake** (*Urophysic chuss*)

The project site is designated as EFH for red hake eggs, larvae, and juveniles. The habitat parameters for the applicable life stages are as follows.



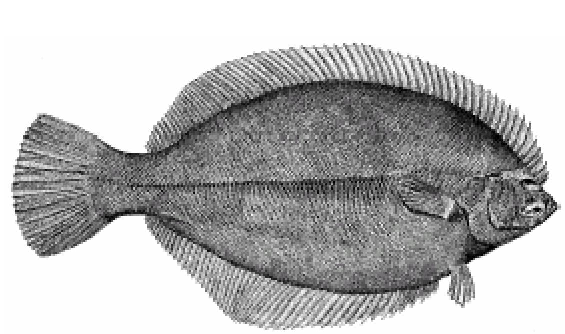
Eggs: Generally, the following conditions exist where hake eggs are found: sea surface water temperatures below 10°C along the inner continental shelf with salinities less than 25%. Red hake eggs are most often observed during the months from May to November, with peaks in June and July.

Larvae: Generally, the following conditions exist where red hake larvae are found: sea surface water temperatures below 19°C, water depths less than 200 meters, and salinities greater than 0.5%. Red hake larvae are most often observed from May through December, with peaks in September and October.

Juveniles: Generally, the following conditions exist where red hake juveniles are found: water temperatures below 16°C, water depths less than 100 meters, and a salinity range from 31 to 33%.

**winter flounder** (*Pleutonectes americanus*)

The project site is designated as EFH for winter flounder eggs, larvae, juveniles, and adults. The habitat parameters for the applicable life stages are as follows.



Eggs: Generally, the following conditions exist where winter flounder eggs are found: water temperatures less than 10°C, salinities between 10 to 30%, and water depths less than 5 meters. Winter flounder eggs are often observed from

February to June.

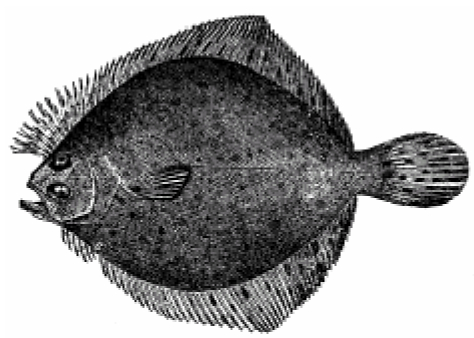
Larvae: Generally, the following conditions exist where winter flounder larvae are found: sea surface water temperatures less than 15°C, salinities between 4 and 30‰, and water depths less than 6 meters. Winter flounder larvae are often observed from March to July.

Juveniles: Generally, the following conditions exist where winter flounder young-of-the-year are found: water temperatures below 28°C, water depths from 0.1 to 10 meters, and salinities between 5 and 33‰. Generally, the following conditions exist where juvenile winter flounder are found: water temperatures below 25°C, water depths from 1 to 50 meters, and salinities between 10 and 30%.

Adults: Generally, the following conditions exist where winter flounder adults are found: water temperatures below 25°C, water depths from 1 to 100 meters, and salinities between 15 and 33%.

**windowpane flounder** (*Scopthalmus aquosus*)

The project site is designated as EFH for windowpane flounder eggs, larvae, juveniles, and adults. The habitat parameters for the applicable life stages are as follows.



Eggs: Generally, the following conditions exist where windowpane flounder eggs are found: sea surface water temperatures less than 20°C and water depths less than 70 meters. Windowpane flounder eggs are often observed from February to November with peaks in May and October.

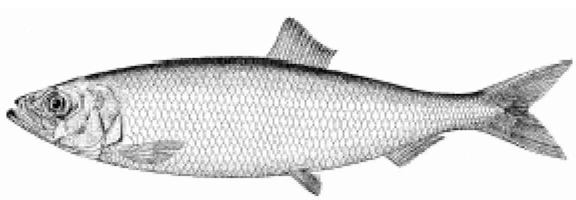
Larvae: Generally, the following conditions exist where windowpane flounder larvae are found: sea surface water temperatures less than 20°C and water depths less than 70 meters. Windowpane flounder larvae are often observed from February to November with peaks in May and October.

Juveniles: Generally, the following conditions exist where windowpane flounder juveniles are found: water temperatures below 25°C, water depths from 1 to 100 meters, and salinities between 5.5 and 36%.

Adults: Generally, the following conditions exist where windowpane flounder adults are found: water temperatures below 26.8°C, water depths from 1 to 75 meters, and salinities between 5.5 and 36%.

**Atlantic herring** (*Clupea harengus)*

The project site is designated as EFH for Atlantic herring juveniles and adults. The habitat parameters for the applicable life stages are as follows.

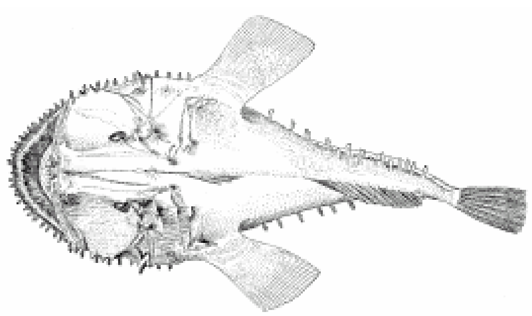


Juveniles: Generally, the following conditions exist where Atlantic herring juveniles are found: water temperatures below 10°C, water depths from 15 to 135 meters, and a salinity range from 26 to 32%.

Adults: Generally, the following conditions exist where Atlantic herring adults are found: water temperatures below 10°C, water depths from 20 to 130 meters, and salinities above 28%

**monkfish** (*Lophius americanus*)

The project site is designated as EFH for monkfish eggs and larvae. The habitat parameters for the applicable life stages are as follows.

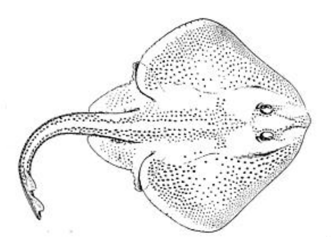


Eggs: Generally, the following conditions exist where monkfish egg veils are found: sea surface water temperatures below 18°C and water depths from 15 to 1000 meters. Monkfish egg veils are most often observed during the months from March to September.

Larvae: Generally, the following conditions exist where monkfish larvae are found: water temperatures 15°C and water depths from 25 to 1000 meters. Monkfish larvae are most often observed during the months from March to September.

**little skate** (*Leucoraja erinacea*)

The project site is designated as EFH for little skate juveniles and adults. The habitat parameters for the applicable life stages are as follows.

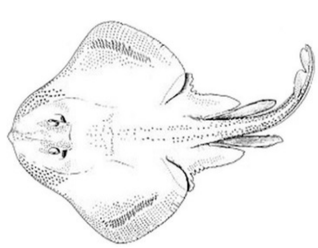


Juveniles: Bottom habitats with a sandy or gravelly substrate or mud, generally found from the shore to depths of 137 meters, with the highest abundance from 73-91 meters. Most juveniles are found between 4-15°C.

Adults: bottom habitats with a sandy or gravelly substrate or mud within the same range as the juveniles.

**winter skate** (*Leucoraja ocellata*)

The project site is designated as EFH for winter skate juveniles and adults. The habitat parameters for the applicable life stages are as follows.



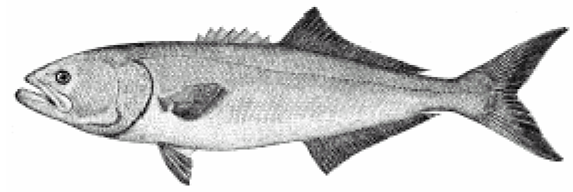
Juveniles: Sand and gravel or mud shoreline to about 400 meters and are most abundant at depths less than 111 meters. The temperature range for these skates is from - 1.2 - 21 °C, with most found from 4-16 °C, depending on the season.

Adults: Sand and gravel or mud substrate found from shoreline to 371 meters, but are most abundant at less than 111 meters. The temperature range is also very similar, with a range from –1.2 - 20 °C, with most found in water with temperatures ranging from 5-15 °C.

3.2 Mid-Atlantic Species

**bluefish** (*Pomatomus saltatrix*)

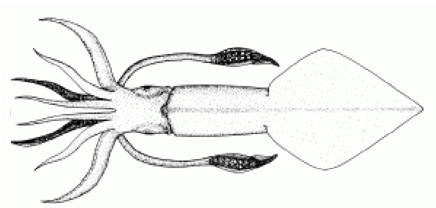
The project site is designated as EFH for bluefish juveniles and adults. The habitat parameters for the applicable life stages are as follows.



Juveniles: Generally juvenile bluefish occur in estuaries from May through October. Typical conditions for juveniles are: water temperatures between 19°C and 24°C and salinities between 23 and 36%.

Adults: Adult bluefish are found in Mid-Atlantic estuaries from April through October. Typical conditions for adults are: water temperatures from 14°C to 16°C and salinities greater than 25%.

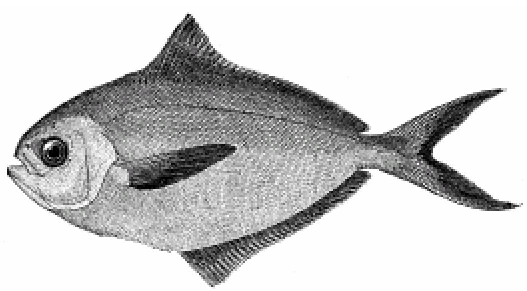
l**ong finned squid** (*Loligo pealei*)



Juveniles: Pre-recruits inhabit upper 10 m at depths of 50-100 m on continental shelf. Pre-recruits are found in coastal inshore waters in spring/fall, offshore in winter. Typical conditions for Pre-recruit juveniles are found at water temperatures between 10°C and 26°C and salinities between 31.5 and 34%.

**Atlantic butterfish** (*Peprilus triacanthus*)

The project site is designated as EFH for Atlantic butterfish larvae, juveniles, and adults. The habitat parameters for the applicable life stages are as follows.



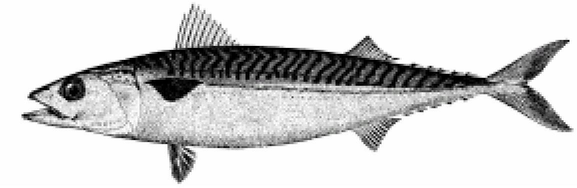
Larvae: Generally, butterfish larvae occur in water depths between 10 and 1830 meters, water temperatures between 9°C and 19°C, and a salinity range of 6.4 to 37%.

Juveniles: Generally, juvenile butterfish occur in water depths between 10 and 365 meters, water temperatures between 3°C and 28°C, and a salinity range of 3 to 37%.

Adults: Generally, adult butterfish occur in water depths between 10 and 365 meters, water temperatures between 3°C and 28°C, and a salinity range of 4 to 26%.

**Atlantic mackerel** (*Scomber scrombrus*)

The project site is designated as EFH for Atlantic mackerel juveniles and adults. The habitat parameters for the applicable life stages are as follows.

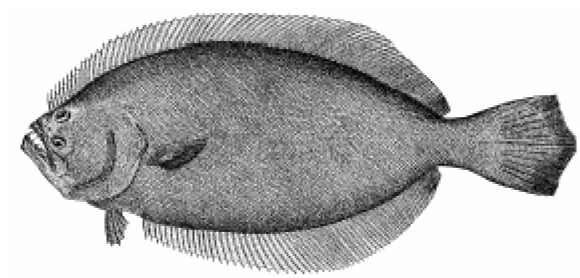


Juveniles: Generally, juvenile Atlantic mackerel occur in water depths between the shore and 320 meters, water temperatures between 4°C and 22°C, and salinities less than 25%.

Adults: Generally, adult Atlantic mackerel occur in water depths between the shore and 380 meters, water temperatures between 4°C and 16°C, and salinities less than 25%.

**summer flounder** (*Paralichthys denntatus*)

The project site is designated as EFH for summer flounder larvae, juveniles, and adults. The habitat parameters for the applicable life stages are as follows.



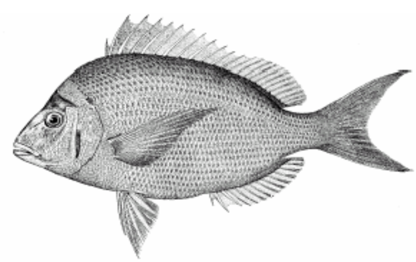
Larvae: In general, summer flounder larvae are most abundant nearshore at water depths between 10 and 70 meters, in water temperatures between 9°C and 12°C, and salinities between 23 to 33‰. They are most frequently found from September to February.

Juveniles: In general, juveniles use several estuarine habitats as nursery areas, including salt marsh creeks, seagrass beds, mudflats, and open bay areas in water temperatures greater than 11°C, water depths from 0.5 to 5 meters, and salinities ranging from 10 to 30%.

Adults: Generally, summer flounder occur in water depths between the shore and 25 meters. Seasonally, they inhabit shallow coastal and estuarine waters during warmer months and move offshore on the outer Continental Shelf at depths of 150 meters in colder months.

**scup** (*Stenotomus chrysop*s)

The project site is designated as EFH for scup eggs, larvae, juveniles, and adults. The habitat parameters for the applicable life stages are as follows.



Eggs: In general, scup eggs are found from May through August, in water temperatures between in water temperatures between 13°C and 23°C, water depths less than 30 meters, and salinities less than 15%.

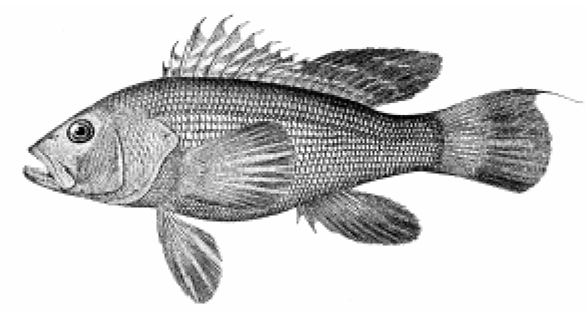
Larvae: In general, scup larvae are most abundant nearshore from May through September, in water temperatures between 13°C and 23°C, water depths less than 20 meters, and salinities less than 15%.

Juveniles: In general, juvenile scup during the summer and spring are found in estuaries and bays, in association with various sands, mud, mussel, and eelgrass bed type substrates, between the shore and water depths of 38 meters. Typical conditions are: water temperatures less than 7°C and salinities less than 15%.

Adults: Generally, adult scup are found in water temperatures less than 7°C, water depths between 2 and 185 meters, and salinities less than 15%. Seasonally, wintering adults (November through April) are usually offshore.

**black sea bass** (*Centropristus striata*)

The project site is designated as EFH for black sea bass juveniles and adults. The habitat parameters for the applicable life stages are as follows.



Juveniles: Juvenile black sea bass are usually found in association with rough bottom, shellfish and eelgrass beds, and man-made structures in sandy-shelly areas. Typical conditions are: water temperatures less than 6°C, water depths between 1 and 38 meters, and salinities less than 18%.

Adults: Structured habitats (natural and man-made), sand and shell are usually the substrate preference of adult black sea bass. Typical conditions are: water temperatures less than 6°C, water depths between 20 and 50 meters, and salinities less than 20%.

3.3 Coastal Migratory Pelagic Species

The project site is designated as EFH for coastal migratory pelagic eggs, larvae, juveniles, and adults. These species are found in sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters, from the surf to the shelf break zone, but from the Gulf Stream shoreward. In addition, all coastal inlets and state-designated nursery habitats are of particular importance to coastal migratory pelagics.

**king mackerel** (*Scomberomorus cavalla*)

In general, king mackerel are found in water temperatures less than 20°C and salinities less than 30%.

spanish mackerel (*Scomberomorus maculates*)

In general, Spanish mackerel are found in water temperatures less than 20°C and salinities less than 30%.

**cobia** (*Rachycentron canadum*)

In addition to the general habitat of the coastal migratory pelagics, Cobia are also found in high salinity bays, estuaries, and seagrass habitat. Typical conditions are: water temperatures less than 20°C and salinities less than 25%.

3.4 Highly Migratory Species

**sand tiger shark** (*Odontaspis taurus*)

The project site is designated as EFH for sand tiger shark neonates. The habitat parameters for the applicable life stages are as follows.

Neonates/early juveniles: Neonates/early juveniles are found in shallow coastal waters to the 25 meter isobath.

**blue shark** (*Prionace glauca*)

The project site is designated as EFH for blue shark adults. The habitat parameters for the applicable life stages are as follows.

Adults: Neonates/early juveniles are found in shallow coastal waters beyond the 25 meter isobath. The temperature preference of blue shark is between 10 to 20°C.

**dusky shark** (*Charcharinus obscurus*)

The project site is designated as EFH for dusky shark neonates. The habitat parameters for the applicable life stages are as follows.

Neonate/early juveniles: Neonates/early juveniles are found in shallow coastal waters, inlets, and estuaries to the 25 meter isobath.

**sandbar shark** (*Charcharinus plumbeus*)

The project site is designated as EFH for sandbar shark neonates, juveniles, and adults. The habitat parameters for the applicable life stages are as follows.

Neonates/early juveniles: Neonates/early juveniles are found in shallow coastal areas to the 25 meter isobath. Typical conditions are: salinities greater than 22% and water temperatures greater than 21°C.

Late juveniles/subadults: Late juveniles/subadults are found offshore.

Adults: Adults are found in shallow coastal areas from the coast to the 50 meter isobath.

**tiger shark** (*Galeocerdo cuvieri*)

The project site is designated as EFH for tiger shark neonates. The habitat parameters for the applicable life stages are as follows.

Neonate/early juveniles: Neonates/early juveniles are found in shallow coastal waters to the 200 meter isobath.

## 4 Effects on EFH Species in Project Area

In general, Tier 1 adverse impacts to federally managed fish species may stem from alterations of the bottom habitat, which result from construction, dredging offshore in the borrow site, groin construction, and beach fill placement in the intertidal zone and nearshore. EFH can be adversely impacted temporarily through water quality impacts such as increased turbidity and decreased dissolved oxygen content in the dredging and placement locations. These impacts would subside upon cessation of construction activities. More long-term impacts to EFH involve physical changes to the bottom habitat, which involve changes to bathymetry, sediment substrate, and benthic community as a food source.

One major concern with respect to physical changes involves the potential loss of prominent offshore sandy shoal habitat within borrow sites due to sand mining for the beach replenishment. It is generally regarded that prominent offshore shoals are areas that are attractive to fish including the federally managed species, and are frequently targeted by recreational and commercial fishermen. Despite this, there is little specific information to determine whether shoals of this type have any enhanced value for fish. However, it is reasonable to expect that the increased habitat complexity at the shoals and adjacent bottom would be more attractive to fish than the flat featureless bottom that characterizes much of the mid-Atlantic coastal region (U.S. Fish and Wildlife Service, 1999a).

Since mining of sand in shoals may result in a significant habitat alteration, it is proposed that these areas be avoided or the flatter areas surrounding the prominent shoals be mined. Prominent shoal habitat was avoided as part of the borrow site screening process. This was accomplished by avoiding sites with prominent shoal habitat such as the “Seaside Lumps” and “Fish Heaven”, which are considered important sport and commercial fishing grounds (Long and Figley, 1984). Other physical alterations to EFH involve substrate modifications. An example would be the conversion of a soft sandy bottom into a hard clay bottom through the removal of overlying sand strata. This could result in a significant change in the benthic community composition after recolonization, or it could provide unsuitable habitat required for surf clam recruitment or spawning of some finfish species. This could be avoided by correlating vibracore strata data with sand thickness to restrict dredging depths to avoid exposing a different substrate. Based on vibracore data, dredging depths would be considered to minimize the exposure of dissimilar substrates.

Biological impacts on EFH are more indirect involving the temporary loss of benthic food prey items or food chain disruptions. Table 2 provides a brief description of direct or indirect impacts on the designated federally managed species and their EFH with respect to their life stage within the designated EFH squares that encompasses the entire project impact area. There are a number of federally managed fish species where EFH was identified for one or more life stages within the project impact areas. Fish occupation of waters within the project impact areas is highly variable spatially and temporally. Some of the species are strictly offshore, while others may occupy both nearshore and offshore waters. In addition, some species may be suited for the open-ocean or pelagic waters, while others may be more oriented to bottom or demersal waters. This can also vary between life stages of federally managed species. Also, seasonal abundances are highly variable, as many species are highly migratory.

Of the 37 species identified with Fishery Management Plans, the proposed project could have direct impacts on habitat for winter flounder eggs and larval stages and entrainment of juvenile black sea bass, whiting, red hake, pollock, winter flounder, windowpane, Atlantic sea herring, long finned squid, summer flounder, and scup. This is attributable to the benthic or demersal nature of these species and their affected life stages. However, the effect on benthic food-prey organisms present in the borrow area and fill placement areas is considered to be temporary as benthic studies have demonstrated recolonization following dredging operations within 13 months to 2 years. Minor elevation differences resulting from dredging may even serve to enhance bottom habitat for a number of these species.

Published information on life history and habitat requirements for EFH-designated species or life history stages that were not collected in bottom trawl surveys of the borrow areas was compiled in order to provide a more complete listing of species to include in this assessment. Based on this information the following EFH-designated species and life history stages were identified as probable occupants of the borrow area:

- Adult scup are often caught over soft, sandy bottoms (Steimle *et al*. 1999a) and most scup occupying Sandy Hook Bay in the summer are young adults (Wilk and Silverman 1976);
- Adult butterfish are common in nearshore open coastal areas, including the surf zone, and occur in sheltered bays and estuaries in the mid-Atlantic region during the summer (Cross *et al*. 1999);
- Juvenile and adult Atlantic mackerel (*Scomber scombrus*) are found in bays and estuarine waters from New Jersey to Canada and are common in saline waters of the Project Area in the spring and fall (Studholme *et al*. 1999);
- Adult Atlantic herring are common in the project area in the winter and early spring (Reid *et al*. 1998);
- Adult and early juvenile sandbar sharks (*Charcharinus obscurus*) can occur in shallow, intertidal waters and bear live young in shallow bays and estuaries of the east-central

- U.S. in the summer (Compagno 1984);
- Juvenile red hake are found in Sandy Hook Bay during the spring and early summer, in much reduced numbers (Able and Fahay 1998) and Reid *et al.* (1979) suggest that juveniles in Long Island Sound prefer silty, fine sand sediments;
- Adult hake occur in the project area during the cooler months (Stone *et al.* 1994) and are abundant in offshore waters of Raritan Bay (Morse *et al.* 1998);
- Adult Atlantic herring occupy mid-Atlantic continental shelf waters in the winter and early spring;

The species and life history stages that are not believed to occupy the proposed borrow areas are king mackerel juveniles and adults, adult spanish mackerel, adult cobia, and early juvenile dusky shark (*Charcharinus obscurus*). King mackerel (*Scomberomorus cavalla*), cobia, and spanish mackerel are southern species that are near the northern limit of their range and rare in project area. They would therefore be rare in project area and only occur in the warmer months, but are not common in estuarine embayments like Raritan Bay and Sandy Hook Bay (Reid *et al*. 1999). Reproducing dusky sharks tend to avoid estuaries (Compagno 1984).

## 4.1 Potential Direct/Indirect Impacts, Cumulative, and Mitigation

Dredging and placement activities in the project area are not expected to have any significant or long-term lasting effects on the “spawning, breeding, feeding, or growth to maturity” of the designated EFH species that occupy the borrow areas. However, the proposed activity would have immediate, short-term, direct and indirect impacts on EFH for some of the designated fish species and life history stages that occur in the immediate vicinity of the borrow and placement areas. This section identifies the direct and indirect impacts that could result from dredging and makes recommendations for minimizing these impacts. Table 6 summarizes these direct and indirect effects.

### 4.1.1 Direct Impacts

Due to the mobility of larger fish, direct impacts from suction dredging and placement would be limited to eggs, larvae, small fish, and benthic invertebrates which would be removed by the dredge. The EFH designated species most likely to suffer mortality from dredging are juvenile winter flounder and windowpane. Mortality of young-of-the-year (YOY) juvenile windowpane and winter flounder would be highest in the spring, just after they settle to the bottom and metamorphose. During that time of year, YOY juveniles are <50 millimeters (mm) long and not capable of avoiding a suction dredge.

Mortalities of small flounder would be minimized if dredging was restricted to the fall (October-December), after they are larger and start to move into deeper water (Pereira *et al*. 1999) and would be less plentiful on shallow borrow areas. Dredging in the fall would also minimize any possible impacts on pelagic fish eggs and larvae produced by EFH- designated species since most of them spawn in the spring.

Unlike any of the other EFH-designated species winter flounder deposit their eggs on the bottom in nearshore waters in depths of 1 to 15 feet on mud, sand, and gravel substrates along the Atlantic coast of New York during the winter (peak spawning in February and March) (Pereira *et al.* 1999). There is a high probability that dredging on borrow areas in the winter would cause the mortality of winter flounder eggs. If dredging was restricted to the fall October- December), any risk of removing winter flounder eggs would be eliminated. Borrow pits left behind after dredging ceases would eventually provide good spawning habitat for winter flounder since the sand that would accumulate in them is substrate for eggs.

According to the NPS environmental documents prepared for borrow efforts indicate the adverse direct impacts will not be significant (GMP/EIS, 2014). Additional minor short-term direct impact on benthic feeding fish species (e.g., windowpane, summer and winter flounder) would be experienced, due to temporary displacement during dredging for borrow areas. Impacts to benthic communities in the borrow area are considered short-term because benthic invertebrate species are expected to recolonize the borrow area within 2-2.5 years (USACE 2001). In addition, impacts are considered minor because benthic feeding fish species are expected to avoid construction areas and feed in the surrounding area; therefore, would not be adversely affected by the temporary localized reduction in available benthic food sources. In summary, there are expected to be no impacts to fish assemblages of finfish foraging habits in offshore borrow areas (USACE 2001).

### 4.1.2 Indirect Impacts

As a result of sand removal (suction dredging) and placement of the material, the most immediate, indirect effect on EFH areas would be the loss of benthic invertebrate prey species. Small motile and sedentary epifaunal species (*e.g.*, small crabs, snails, tube- dwelling amphipods), and all infaunal species (*e.g.*, polychaetes), would be most vulnerable to suction dredging and burial. However, impacts would be short term as infaunal organisms are likely to recolonize the area from nearby communities and re-establish to a similar community within a 2 - 6.5 month period (USACE 1995; USACE 2001).

The EFH-designated species most vulnerable to the loss of prey organisms are winter flounder, windowpane, scup, and black sea bass. Winter flounder are obligate bottom feeders, preying primarily on infaunal polychaetes and tube-dwelling amphipods. The removal of benthic prey organisms will affect them more directly than any other EFH species. Windowpane have larger mouths than winter flounder and feed primarily on small crustaceans (*i.e.*, mysid and decapod shrimp) and fish larvae. These are motile prey organisms that live in the water column or near the bottom and could, to some extent, avoid being removed by the dredge. Scup and black sea bass feed on a variety of benthic infaunal and epifaunal organisms that would be affected by dredging. The immediate impact of prey removal would be negligible since bottom feeding EFH species would re- locate to nearby areas with intact benthic food resources. It would also be a temporary condition, lasting only as long as it takes for benthic organisms to re-colonize the dredged area. In addition, the dislocation of some benthic prey organisms into the water column by the dredge will attract fish to the area to feed (Brinkhuis 1980).

The removal of sand leaves a depression or hole (borrow pit) in the sea floor that can persist for years. The rate at which borrow pits fill up will depend on the amount of sediment that is available and the direction and strength of currents in the area. Borrow pits can modify the habitat for benthic, bottom-feeding fishes since they are deeper than the surrounding sea floor and act as traps for fine grained sediments. Accumulation of mud can cause a change in benthic community structure that favors certain species of fish. Also, if circulation of bottom water in the pits is reduced, DO can fall to low enough levels (<2-3 ppm) that fish will avoid them all together. High organic contents of mud accumulating in pits could also cause oxygen depletion.

Studies performed in the Lower Bay of New York Harbor have shown that benthic community structure is disrupted by dredging, but can reach a new equilibrium fairly rapidly. Cerrato and Scheier (1984) found that the borrow pits on the West Bank of the Ambrose Channel had distinctly different habitats from a nearby undredged control site. The benthic fauna at the control site was more diverse (*i.e.*, more species) and, in general, more stable (less susceptible to seasonal shifts in species composition and abundance) through time, whereas there were fewer species in the borrow pits, but some of them were very abundant. In a related study, Conover *et al.* (1985) found that fish, including some EFH-designated species, were actually more abundant in borrow pits. Of the EFH designated species, butterfish (mostly juveniles) were more abundant in the borrow pits, as were winter flounder (in the fall). Red hake were more abundant in one of the borrow pits and the largest catches of windowpane were made in one of the pits in the spring.

Summer flounder were generally more abundant in the borrow pits.

In addition, Conover *et al.* (1985) also examined the stomach contents of winter flounder in the three sampling sites and related them to benthic populations identified by Cerrato and Scheier (1984). The results indicated that, despite changes in the species composition of benthic communities after dredging, the feeding success of winter flounder in the pits was not affected. Winter flounder, like many other bottom-feeding species, are selective feeders that adapt their diets to whatever prey species are readily available. These results suggest that the feeding success of other bottom-feeding EFH species is also likely to not be affected by changes in benthic community structure caused by dredging.

The degree to which water quality is degraded, or temperature and salinity changes in borrow pits depends on the depth of the pit, the circulation of water through the pit, and the amount of fine sediment and organic matter that accumulates in the pit. Conover *et al*. (1985) determined that summer water temperatures tended to be lower in borrow pits and salinities consistently higher (generally by 1-3 ppt, but by 7.3 ppt in January). More importantly, DO concentrations measured between June and November did not vary between sites.

Bottom currents along the project area shore are strong, thus it is likely that DO levels near the bottom of borrow pits in project area would not be reduced, There is, in fact, so much sand that is transported west along the outer New York coast that any hole created by dredging would fill in naturally within a very short time. If fine sediments accumulate in them, the benthic invertebrate community will change from a sand-dominated to a mud-dominated fauna. However, as long as water quality is not degraded, there would be no adverse impact on EFH. In fact, if summer water temperatures in borrow pits are lower than on adjacent shoal areas, EFH might be improved. Monitoring of DO levels in borrow pits would indicate whether or not remedial action needs to be taken to improve habitat quality. Limiting the depth to which dredging would proceed and/or filling the borrow pits, partially or totally, with clean fill when oxygen concentrations drop to unacceptable levels after dredging would reduce the possibility of DO concentration levels falling below 2-3 ppm.

Table 6. Direct and Indirect Impacts on Identified EFH Species for Representative Life Stages

| Species | Eggs | Larvae | Juveniles | Adults |
|---|---|---|---|---|
| Atlantic salmon (*Salmo salar*) | | | | **Direct Impacts:** Adults are pelagic and highly migratory, therefore no adverse impacts are anticipated.<br>**Indirect Impacts:** Minor indirect adverse effects on food chain through disruption of benthic community, however, salmon are highly migratory. |
| pollock (*Pollachius virens*) | | | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of juveniles could be expected from entrainment into the dredge.<br>**Indirect:** Temporary disruption of benthic food prey organisms. | |
| whiting (*Merluccius bilinearis*) | Eggs are pelagic and are concentrated in depth of 50 – 150 meters, therefore no direct or indirect effects are expected. | Larvae are pelagic and are concentrated in depth of 50 –150 meters, therefore no direct or indirect effects are expected. | **Direct:** Occur near bottom. Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of juveniles could be expected from entrainment into the dredge.<br>**Indirect:** Temporary disruption of benthic food prey organisms. | |

| Species | Eggs | Larvae | Juveniles | Adults |
|---|---|---|---|---|
| red hake (*Urophycis chuss*) | Eggs occur in surface waters; therefore, no direct or indirect effects are expected. | Larvae occur in surface waters; therefore, no direct or indirect effects are expected. | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of juveniles could be expected from entrainment into the dredge.<br>**Indirect:** Temporary disruption of benthic food prey organisms. | |
| winter flounder (*Pleuronectes americanus*) | Eggs are demersal in very shallow waters of coves and inlets in Spring.<br>Dredging may have some effect on eggs if construction occurs during Spring. | Larvae are initially planktonic, but become more bottom-oriented as they develop. Potential for some to become entrained during dredging in borrow areas. | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of juveniles could be expected from entrainment into the dredge.<br>**Indirect:** Temporary disruption of benthic food prey organisms | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions.<br>**Indirect:** Temporary disruption of benthic food prey organisms. |
| windowpane flounder (*Scopthalmus aquosus*) | Eggs occur in surface waters; therefore, no direct or indirect effects are expected. | Larvae occur in pelagic waters; therefore, no direct or indirect effects are expected. | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of juveniles could be expected from entrainment into the dredge.<br>**Indirect:** Temporary disruption of benthic food prey organisms. | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions.<br>**Indirect:** Temporary disruption of benthic food prey organisms. |

| Species | Eggs | Larvae | Juveniles | Adults |
|---|---|---|---|---|
| Atlantic herring (*Clupea harengus*) | | | **Direct:** Occur in pelagic and near bottom.<br>Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of juveniles could be expected from entrainment into the dredge.<br>**Indirect:** None, prey items are planktonic. | **Direct:** Occur in pelagic and near bottom.<br>Physical habitat in borrow site should remain basically similar to pre-dredge conditions.<br>**Indirect:** None, prey items are primarily planktonic. |
| monkfish (*Lophius americanus*) | Eggs occur in surface waters with depths greater than 75 ft; therefore, no direct or indirect effects are expected. | Larvae occur in pelagic waters with depths greater than 75 ft; therefore, no direct or indirect effects are expected. | | X |
| Little skate (*Leucoraja erinacea*) | | | **Direct:** Juvenile skate are pelagic species. No significant direct effects anticipated.<br>**Indirect:** Temporary disruption of benthic food prey organisms. | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Adults should be capable of relocating during impact.<br>**Indirect:** Temporary disruption of benthic food prey organisms. |
| Winter skate (*Leucoraja ocellata*) | | | **Direct:** Juvenile butterfish are pelagic species. No significant direct effects anticipated.<br>**Indirect:** Temporary disruption of benthic food prey organisms. | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Adults should be capable of relocating during impact.<br>**Indirect:** Temporary disruption of benthic food prey organisms. |

| Species | Eggs | Larvae | Juveniles | Adults |
|---|---|---|---|---|
| bluefish (*Pomatomus saltatrix*) | | | **Direct:** Juvenile bluefish are pelagic species. No significant direct effects anticipated.<br>**Indirect:** Temporary disruption of benthic food prey organisms. | **Direct:** Adult bluefish are pelagic species. No significant direct effects anticipated.<br>**Indirect:** Temporary disruption of benthic food prey organisms. |
| long finned squid (*Loligo pealei*) | n/a | n/a | **Direct:** squid tend to be demersal during the day and pelagic at night (Hammer, 2000). There is a potential for entrainment. | |
| short finned squid (*Illex illecebrosus*) | n/a | n/a | | |
| Atlantic butterfish (*Peprilus triacanthus*) | **Direct:** Eggs are pelagic, therefore no adverse impacts are anticipated.<br>**Indirect:** None anticipated. | **Direct:** Larvae are pelagic, therefore no adverse impacts are anticipated.<br>**Indirect:** None anticipated. | **Direct:** Juvenile butterfish are pelagic species. No significant direct effects anticipated.<br>**Indirect:** Temporary disruption of benthic food prey organisms. | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Adults should be capable of relocating during impact.<br>**Indirect:** Temporary disruption of benthic food prey organisms. |
| Atlantic mackerel (*Scomber scombrus*) | **Direct:** Eggs are pelagic, therefore no adverse impacts are anticipated.<br>**Indirect:** None anticipated. | **Direct:** Larvae are pelagic, therefore no adverse impacts are anticipated.<br>**Indirect:** None anticipated. | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of juveniles could be expected from entrainment into the dredge.<br>**Indirect:** Temporary disruption of benthic food prey organisms. | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions.<br>**Indirect:** Temporary disruption of benthic food prey organisms. |

| Species | Eggs | Larvae | Juveniles | Adults |
|---|---|---|---|---|
| summer flounder (*Paralicthys dentatus*) | | X | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of juveniles could be expected from entrainment into the dredge.<br>**Indirect:** Temporary disruption of benthic food prey organisms. | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions.<br>**Indirect:** Temporary disruption of benthic food prey organisms. |
| scup (*Stenotomus chrysops*) | **Direct:** Eggs are pelagic, therefore no adverse impacts are anticipated.<br>**Indirect:** None anticipated | Larvae are initially planktonic, but become more bottom-oriented as they develop. Potential for some to become entrained during dredging in borrow areas (Steimle et al. 1999c). | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of juveniles could be expected from entrainment into the dredge.<br>**Indirect:** Temporary disruption of benthic food prey organisms. | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Adults should be capable of relocating during impact.<br>**Indirect:** Temporary disruption of benthic food prey organisms. |
| spiny dogfish (*Squalus acanthias*) | n/a | n/a | | |

| Species | Eggs | Larvae | Juveniles | Adults |
|---|---|---|---|---|
| black sea bass (*Centropristus striata*) | n/a | | **Direct:** Physical habitat in borrow sites should remain basically similar to pre-dredge conditions. Offshore sites are mainly sandy soft-bottoms, however, some pockets of gravelly or shelly bottom may be impacted. Some mortality of juveniles could be expected from entrainment into the dredge. Some intertidal and subtidal rocky habitat may be impacted due to sand partially covering groins and potential shipwrecks along the shoreline.<br>**Indirect:** Temporary disruption of benthic food prey organisms. | **Direct:** Physical habitat in borrow sites should remain basically similar to pre-dredge conditions. Offshore sites are mainly sandy soft-bottoms, however, some pockets of gravelly or shelly bottom may be impacted. Some intertidal and subtidal rocky habitat may be impacted due to sand partially covering groins and potential shipwrecks along the shoreline.<br>**Indirect:** Temporary disruption of benthic food prey organisms. |
| surf clam (*Spisula solidissima*) | n/a | n/a | | |
| ocean quahog (*Artica islandica*) | n/a | n/a | | |
| king mackerel (*Scomberomorus cavalla*) | **Direct:** Eggs are pelagic, therefore no adverse impacts are anticipated.<br>**Impacts:** None anticipated. | **Direct:** Larvae are pelagic, therefore no adverse impacts are anticipated.<br>**Indirect:** None anticipated. | **Direct:** Juveniles are pelagic, therefore no adverse impacts are anticipated.<br>**Indirect:** Minor indirect adverse effects on food chain through disruption of benthic community, however, mackerel are highly migratory. | **Direct:** Adults are pelagic and highly migratory, therefore no adverse impacts are anticipated.<br>**Indirect:** Minor indirect adverse effects on food chain through disruption of benthic community, however, mackerel are highly migratory. |

| Species | Eggs | Larvae | Juveniles | Adults |
|---|---|---|---|---|
| Spanish mackerel (*Scomberomorus maculatus*) | **Direct:** Eggs are pelagic, therefore no adverse impacts are anticipated.<br>**Indirect:** None anticipated. | **Direct:** Larvae are pelagic, therefore no adverse impacts are anticipated.<br>**Indirect:** None anticipated. | **Direct:** Juveniles are pelagic, therefore no adverse impacts are anticipated.<br>**Indirect:** Minor indirect adverse effects on food chain through disruption of benthic community, however, mackerel are highly migratory. | **Direct:** Adults are pelagic and highly migratory, therefore no adverse impacts are anticipated.<br>**Indirect:** Minor indirect adverse effects on food chain through disruption of benthic community, however, mackerel are highly migratory. |
| cobia (*Rachycentron canadum*) | **Direct:** Eggs are pelagic, therefore no adverse impacts are anticipated.<br>**Indirect:** None anticipated. | **Direct:** Larvae are pelagic, therefore no adverse impacts are anticipated.<br>**Indirect:** None anticipated. | **Direct:** Cobia are pelagic and migratory species. No significant direct effects anticipated.<br>**Indirect:** Temporary disruption of benthic food prey organisms. | **Direct:** Cobia are pelagic and migratory species. No significant direct effects anticipated.<br>**Indirect:** Temporary disruption of benthic food prey organisms. |
| sand tiger shark (*Odontaspis taurus*) | | **Direct:** Physical habitat in borrow site should remain basically similar to predredge conditions. Mortality from dredge unlikely because embryos are reported up to 39 inches in length. Therefore, the newborn may be mobile enough to avoid a dredge or placement areas.<br>**Indirect:** Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites. | | |

| Species | Eggs | Larvae | Juveniles | Adults |
|---|---|---|---|---|
| blue shark (*Prionace glauca*) | | | | **Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Adults are highly mobile and are capable of avoiding impact areas.<br>**Indirect:** Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites. |
| dusky shark (*Charcharinus obscurus*) | | **Direct:** Physical habitat in borrow site should remain basically similar to predredge conditions. Mortality from dredge unlikely because embryos are reported up to 3 feet in length (McClane, 1978).<br>Therefore, the newborn may be mobile enough to avoid a dredge or placement areas.<br>**Indirect:** Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites. | | |

| Species | Eggs | Larvae | Juveniles | Adults |
|---|---|---|---|---|
| sandbar shark (*Charcharinus plumbeus*) | | Direct: Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of larvae may be possible from entrainment into the dredge or burial in nearshore, but not likely since newborns are approx. 1.5 ft in length (pers. conv. between J. Brady-USACE and H.W. Pratt-NMFS) and are considered to be mobile.<br>Indirect: Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites. | Direct: Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Juveniles are mobile and are capable of avoiding impact areas.<br>Indirect: Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites. | Direct: Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Adults are highly mobile and are capable of avoiding impact areas.<br>Indirect: Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites. |

| Species | Eggs | Larvae | Juveniles | Adults |
|---|---|---|---|---|
| tiger shark (*Galeocerdo cuvieri*) | | Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Mortality from dredge or fill placement unlikely because newborn are reported up to 1.5 feet in length (McClane, 1978). Therefore, the newborn may be mobile enough to avoid a dredge or placement areas. Indirect: Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites. | | |

### 4.1.3 Cumulative Impacts

Given the growth capacity of EFH-designated fish populations within project area and the expected recolonization rates of benthic prey species (i.e., 2-2.5 years), there would be no expected cumulative effects. Cumulative impacts can be avoided by dredging at times of year when EFH-designated species are not spawning.

In summary, the cumulative impacts on EFH are not considered significant consistent with previous consultation pertaining to off-shore borrow areas. Like the benthic environment, the impacts to EFH are temporary in nature and do not result in a permanent loss in EFH. Impacts to benthic communities in the borrow area are considered short-term and minor because benthic invertebrate species are expected to recolonize the borrow area within 2-2.5 years (USACE 2001). Infaunal organisms are likely to recolonize the area from nearby communities and re-establish to a similar community within a 2 - 6.5 month period (USACE 2001). Impacts to fish community assemblages are considered minor (USACE 2001), given the large extent of the Atlantic Ocean and Jamaica Bay compared to the project construction footprint, and recolonization rates of benthic communities. Only short-term adverse impacts would occur because of short-term changes to water quality during construction, including resuspension of sediments in the water column and changes to the quality or quantity of soft bottom substrates.

The borrow sites proposed for this project do not contain prominent shoal habitat features, wrecks and reefs, or any known hard bottom features that could be permanently lost due to the impacts from dredging. These types of habitat were avoided through careful site selection and coordination with fishery resource agencies. Some minor and temporary impacts would result in a loss of food source in the affected areas with each periodic nourishment. This impact would affect demersal or bottom-feeding EFH species such as summer flounder and windowpane. Cumulative losses of EFH can be avoided by not dredging deep holes, and leaving similar sandy substrate (with 3 feet of sand or more) for recruitment.

It should be noted, however, that some fishery habitat might be slightly impacted over time in the nearshore area. As previously discussed, construction of the gates, groins, and other structures which will provide some form of hard structure for fish habitat. These targets could be impacted over time as the construction template stabilizes into the design template to meet existing conditions. This is accomplished through the migration of sand and sediment. This migration of sand and sediment has the potential to cover part, or all of any hardened structure within the nearshore area. It is anticipated that these impacts would be minor and would most likely only result in an accumulation of sand and sediment around the bottom of any given structure.

Steps taken to minimize impacts during construction are also fairly standard among the District's projects. Dredging windows are employed when necessary, dredging is conducted in a manner to avoid creating deep pits, dredging locations within borrow areas are rotated when possible to reduce impacts, buffer areas are established around cultural targets within borrow areas, and borrow areas are chosen to minimize impacts to shellfish and fisheries resources. With the inclusion of these measures in all projects, cumulative impacts for the District activities are expected to be minimized to the greatest extent possible.

# 5 Monitoring

The District plans to conduct a biological monitoring program (BMP) to evaluate the effects of dredging clean sand for flood control/shoreline stabilization construction activities for five years, similar to the plan accepted for Long Beach Island Hurricane and Storm Damage Reduction project. The offshore area to be evaluated is the borrow area (Figure 2) and it will be compared to the 1994 date collected as well as comparing the date to East Rockaway benthic date. The offshore and nearshore components will focus on benthic infauna, grain size, and water quality. The following provides a brief outline of the District's proposed BMP for the offshore borrow areas in the project area. A more detailed plan will be developed prior to implementation.

The collection of benthic fauna is scheduled to occur every spring and fall for five continuous years: one year of pre-construction, one year during construction, and three years of post-construction. The BMP will involve establishing fifty evenly-spaced sampling stations in the borrow area. Prior to the initial sampling events, Differential Georeferenced Positioning System (DGPS) coordinates will be established to ensure that subsequent sampling events will be conducted at the same locations. At each benthic station, water quality will be collected (at the bottom, mid-depth, and surface) and one benthic and grain size sample will be collected using a ¼ cubic yard Smyth-MacIntyre spring-loaded benthic grab. Each benthic sample will be preserved in a 10% formaldehyde solution and shipped to a pre-approved laboratory for analysis. The laboratory will sort, identify, weigh, and numerate species to the lowest practical identification level (LPIL). Grain size samples will be analyzed to determine the percentage of sand, silt, and clay.

## 6 EFH Conservation Measures and Conclusions

The District will notify NMFS prior to commencement of each dredging event prior to the solicitation of bids to ensure the EFH conservation recommendations remain valid. The District will also report annually to NMFS the areas of area dredged including volumes and depths removed.

Surf clam surveys would be conducted prior to construction so that areas of high densities can be identified and avoided. Copies of the survey results will be provided to NMFS.

Implementation of the selected plan will have an overall beneficial effect on existing shellfish and macroinvertebrate species, as well as some finfish species. Therefore, the project will not cause any adverse effects to EFH or EFH species.

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